TE | VI | MECH | Hydraulic Machinery

17.05.12

Con. 3739-12.

GN–7133

(3 Hours) [Total Marks : 100

N.B. (1) Question No. 1 is **compulsory**.
(2) Attempt any **four** questions out of remaining **six** questions.
(3) Assume suitable data wherever **necessary**.
(4) **Figures** to the **right** indicate marks.

1. Answer any **four** of the following questions 20

i) Explain the difference between impulse and reaction turbines.

ii) What is the importance of the governing of the turbine? How is it done in Kaplan turbine?

iii) What is the function of air vessel in reciprocating pump?

iv) What are the advantages and disadvantages of Hydroelectric power plant over other types of power plant?

v) What is priming in centrifugal pump? Why is it necessary?

2. (A) A single jet Pelton wheel turbine is required to drive a generator to develop 10000 kW. The available head at the nozzle is 760 m. Assume the following: Electric generator efficiency 95 %, Pelton wheel efficiency 87 %, coefficient of velocity for nozzle 0.97, mean bucket velocity 0.46 of jet velocity, outlet angle of buckets 15° and relative velocity of the water leaving the buckets 0.85 of that at inlet, Find – 14

i) Diameter of jet
ii) Flow in m^3/s
iii) Force exerted by jet on the buckets.

(B) Why Pelton turbine is not suitable for low head and high discharge? 06

3. (A) Calculate the leading dimensions of the runner of an inward flow reaction turbine to develop 750 kW under a head of 100 m assuming the following data: 16

Guide vane angle = 18°
Axial length of blade at inlet = 0.1 times outer diameter
Outlet diameter = 0.6 time the inlet diameter
Radial velocity of flow = constant
Final discharge = Radial
Hydraulic efficiency = 0.88
Overall efficiency = 0.86
Allowance for blade thickness = 5 %
Speed in rpm = 1000

(B) Explain the function of guide vanes in reaction turbine. 04

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4. (A) The following data refer to an elbow type draft tube :- 12

Area of circular inlet = 25 m^2

Area of rectangular outlet = 116 m^2

Velocity of water at inlet to draft tube = 10m/s

Efficiency of draft tube = 70 %

Height of draft tube inlet above tail race = 0.6 m

Calculate –

i) Vacuum at inlet to draft tube.

ii) Power wasted in the draft tube.

iii) Power lost to tail race.

(B) What is mean by cavitation? What is Thoma's cavitation factor, what is its significance for water turbines? 08

5. (A) A centrifugal pump is required to discharge 0.2 m^3/s of water against a head of 22 m when the impeller rotates at a speed of 1500 rpm. The manometric efficiency is 75 %. The loss of head in pump in meters due to fluid resistance is 0.03 V_2^2 where V_2 is the velocity of water leaving the impeller in m/s. The area of the impeller outlet surface is 1.2 D_2^2 in m^2, where D_2 is the impeller diameter in m. Determine – 14

i) The impeller diameter

ii) The outlet vane angle

Assume that the water enters the impeller without whirl.

(B) What is NPSH? What is the difference between NPSH available and NPSH required? 06

6. (A) A single acting reciprocating pump has a plunger of 80 mm diameter and a stroke is 150 mm. It takes its supply of water from a sump 3 m below the pump through a pipe 4.5 m long and 30 mm diameter. It delivers water to a tank 12 m above the pump through a pipe of 25 mm diameter and 15 m long. If separation occurs at 78.48 kN/m^2 below atmospheric pressure, find the maximum speed at which the pump may be operated without separation, assume the plunger to have simple harmonic motion. 12

(B) Write short note on performance characteristics of Reciprocating pump. 08

7. (A) A centrifugal pump runs at 1440 r.p.m. The impeller is 40 cm in diameter and 2.5 cm wide at outlet. The pump lifts water through height of 30 m of which suction lift is 2.5 m. The suction and delivery pipes are 30 cm in diameter. The losses due to friction in suction and delivery pipes are 1.5 m and 5.5 m respectively. The exit blade angle is 25°. Assume the flow to be radial at inlet and manometric efficiency of 84 %. 14

Calculate –

i) Quantity of water flowing.

ii) Pressure at suction and delivery end of pump if atmospheric pressure is 10.35 m of water.

(B) What is a multistage pump? Discuss the variation of pressure head and velocity in the successive stages in multistage pumps. 06